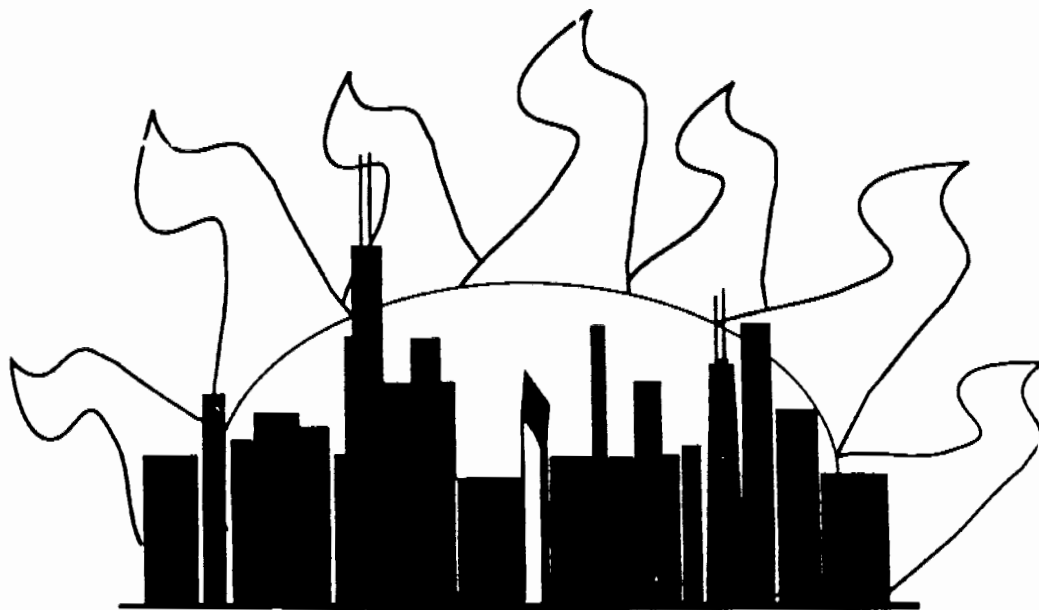**Mu Division**  **Topic Test  2**

# Computer Science



Mu Alpha Theta National Convention
Chicago 1998

**General Instructions:**

Unless otherwise stated all answers should be written as decimals.

If you are asked to give your answer as a fraction, please give your answer in $a\,/\,b$ form where $a$ and $b$ are relatively prime.

### Questions

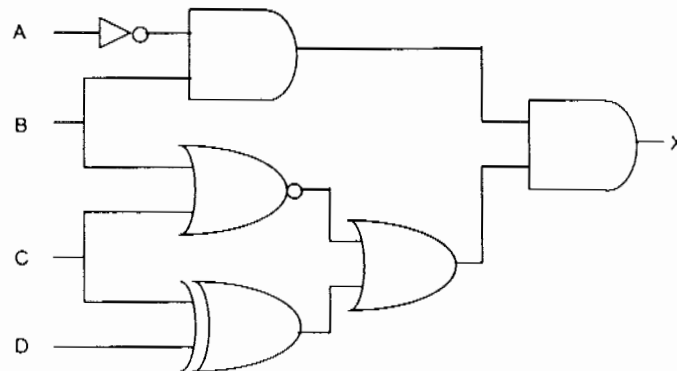1.    Simplify and leave your answer in base 8.
$$\frac{111_{(2)} * 444_{(8)} * 888_{(16)}}{111_{(16)}}$$

2.    How many bit strings of length 5 satisfy the following equation?
$$(10110\ OR\ X)\ AND\ (01100\ OR\ 10101) = 11100$$

3.    Evaluate the following prefix expression
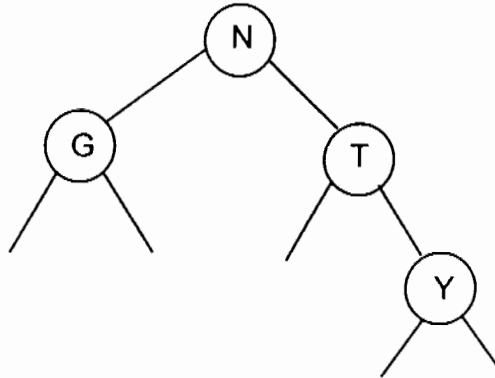$$* + * 3\ 5 - 7\ 4\ /\ * 9\ 2\ 6$$

4.    How many ordered 4-tuples of binary inputs (A, B, C, D) make X true?



5.    Evaluate f(2751), given
$$f(x) = \begin{cases} x & \text{if } x < 5 \\ 10 * f(x\ DIV\ 5) + x & \text{if } x \geq 5 \end{cases}$$

6.     Suppose the words "Gatlinburg", "Tenn", "Next", and "Year" were used as input to produce a binary search tree. How many different orderings would produce the tree below?

```
              N
            /   \
           G     T
          / \   /
               Y
              / \
```

7.     Assume that the input line is the character string "135274". What is the output of the following program segment?

```
while not eoln(F) do
  begin
   read (F, ch);
   if eoln(F) then
     write('.')
   else if ch < '5' then
     write(ch);
  end;
```

8.     What are the first 5 non-zero digits in the base 8 expansion of the base 8 fraction 5/6?

9.     Given  $f(x, y) = \begin{cases} x + f(x+1, y) & \text{if } x \text{ is odd and } x > 0 \\ y + f(x/2, y-3) & \text{if } x \text{ is even and } y > 0 \\ 2x + y & \text{otherwise} \end{cases}$

10.    Find the value of f(17,8).

What is the output of the following program?  Assume that the numbers are output <u>without</u> any blanks between them.

```
program test;

var
 x,y: integer;

function min(x,y:integer):integer;
 begin
     if (x < y) then min := x
     else min := y;
 end;

procedure OhWell(var x:integer; y:integer);
 begin
     x := x + y;
     y := y + 2;
     write(y);
 end;

procedure OhOh(x:integer; var y:integer);
 begin
     x := x DIV 2;
     y := min(x,y);
     write(x);
     OhWell(y,x);
 end;

begin
 x := 6;
 y := 3;
 OhWell(x,y);
 OhOh(y,x);
 write(x);
 write(y);
end.
```

11.    Let X be a binary bit string of length 5.  How many different values of X satisfy the equation:

X AND (10011) OR 10100 = 10110

12. What is the output of the following program?

```
program test;

var  count: integer;

function buildAns(myString: string; myChar: char): integer;
var  count, answer: integer;
begin
    answer := 0;
    for count := 1 to length(myString) do
        if myString[count] = myChar then
            answer := answer + 4
        else
            answer := answer + 2;
    buildAns := answer;
end;

procedure checkAns(answer: integer);
begin
    while answer > 1 do
        begin
            if answer MOD 2 = 0 then write('x')
            else write('y');
            answer := answer DIV 2;
        end;
end;

begin
    count := buildAns("MU_ALPHA_THETA", 'A');
    checkAns(count);
end.
```

13. What is the sum of the numerator and demonator of the following fraction when it is written in base 10 and simplified?

$$( (0.7A4_{(16)} / 0.7_{(8)} ) / 0.0101_{(2)})$$

14. Consider the following functions defined on binary bit strings:
rShift-n = shifts the bits n-places to the right and fills in the beginning with 0's
rCircle-n = remove the rightmost n bits and place them at the beginning of the string.
lShift-n = the same as rShift-n only move left.
lCircle-n = the same as rCircle-n, only circle left.
Evaluate the expression:

rCircle-2 ( rShift-1 (10101) OR lCircle-2 (10110) )

15.     What is the value of the following prefix expression, if a = 5, b = 3 and c = 2?

$$/ * a + b - * c a b c$$

16.     Simplify the following boolean expression:

$$\overline{(\overline{x} + \overline{y})}\overline{(\overline{z}\overline{x})}$$

17.     What is the output of the following program if the input data is:
        25, 16, 31, 41, 20, 1, 0, 3, -15?
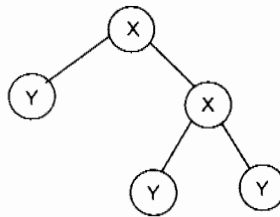
```
program test;

var m,n: integer;

begin
    m := 0;
    repeat
        read(n);
        if NOT(n MOD 2 = 0) then
            m := m + n;
    until n < 0;
    writeln(m);
end.
```

18.     If the following tree is transversed in postorder, what is the order of the output?



19.     What is the maximum internal path length of a binary tree that contains 15 nodes?

20.     A heap in implemented using a binary tree. If the heap is created using the string "Computer_Science_Rocks", how many leaves are in the tree?